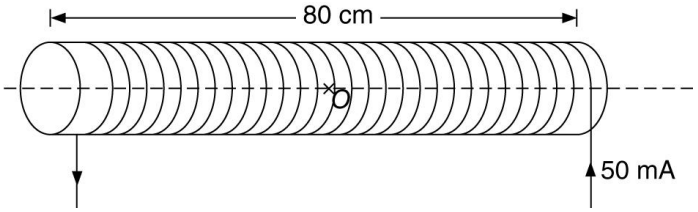
{{<P=41><C=05><S=extension><T=SQ><M=5><L=1><X=F><id=001>}}

4152001

F E The figure below shows a solenoid of length 80 cm. The solenoid has 500 turns and it carries a current of 50 mA.

(Given the permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})



(a) Find the magnitude of the magnetic field at the centre *O* of the solenoid. (2 marks)

(b) What is the major assumption in (a)? (1 mark)

(c) A search coil of 5000 turns and an area of 1.5 cm^2 is placed at *O*. The plane of the coil is perpendicular to the magnetic field. Calculate the magnetic flux linkage through the search coil. (2 marks)

4152002

F E A square wire frame, each side of length 10 cm, is placed in a uniform magnetic field of 1.5 T. The direction of the magnetic field is pointing upwards.

(a) Find the magnetic flux through the frame when the plane of the frame

(i) is placed horizontally,

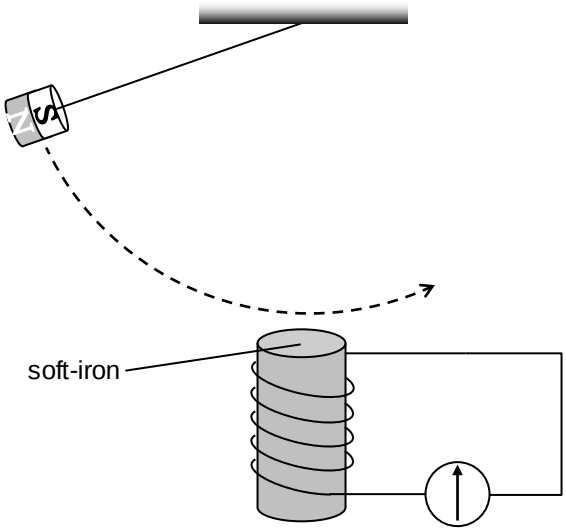
(ii) is placed vertically,

(iii) makes an angle of 60° with the vertical. (4 marks)

(b) The magnetic field is reduced constantly to zero in 2 s. Find the induced e.m.f. in the frame in each of the above cases. (4 marks)

4152003

The bob of a pendulum is a permanent magnet and it swings above a coil connected to a centre-zero galvanometer.

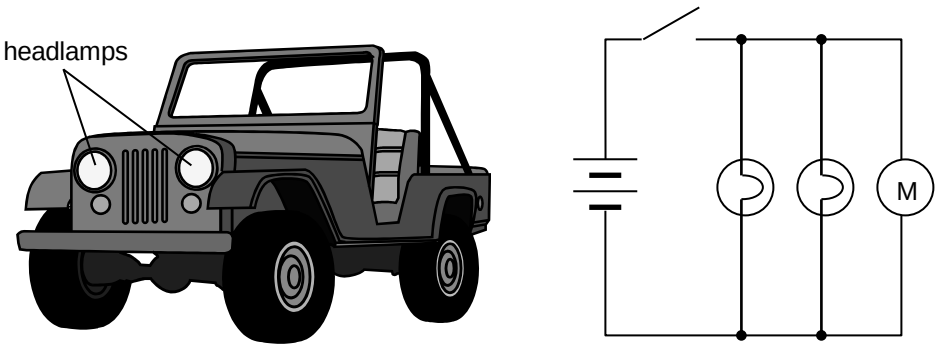


(a) Describe the movement of the pointer of the galvanometer when the magnet swings towards and passes the coil, as shown in the above figure. (2 marks)

(b) The magnet finally stops right above the coil. What happens to the pointer of the galvanometer then? Explain briefly. (2 marks)

4152004

A battery-powered toy car has a built-in motor and two bulbs which act as its headlamps. The electric circuit showing how the components are connected is given below.

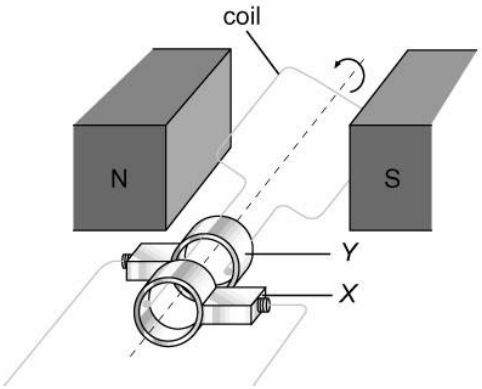


(a) If the switch is closed, describe briefly what will happen to the toy car. (2 marks)

(b) The switch is now open and the toy car is pushed on the ground such that its wheels are turned by friction. Describe and explain briefly what happens to the headlamps of the toy car. (3 marks)

4152005

A simple generator is shown in the following figure.



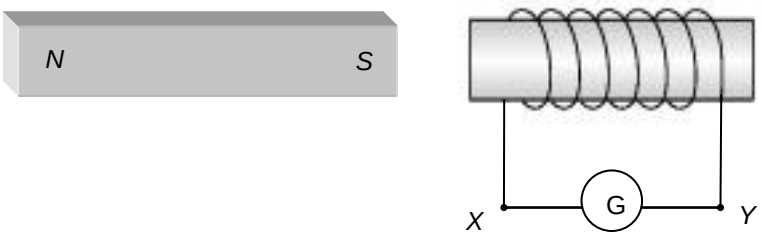
(a) Is it an a.c. or a d.c. generator? (1 mark)

(b) What is the function of the combination of *X* and *Y*? (1 mark)

(c) State two ways to increase the amplitude of the voltage output without changing its frequency. (2 marks)

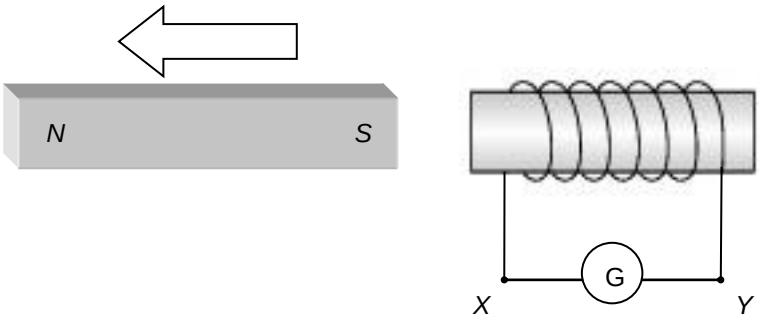
4152006

A bar magnet is placed near a solenoid that connects to a galvanometer. When a current flows from *X* to *Y* through the galvanometer, the reading is positive.



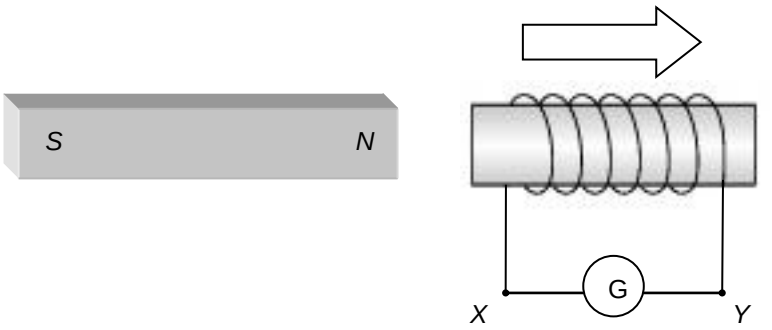
In the following cases, the big arrow indicates the direction of the motion of the magnet or the solenoid. State whether the reading is positive, negative, or zero in each case.

(a)



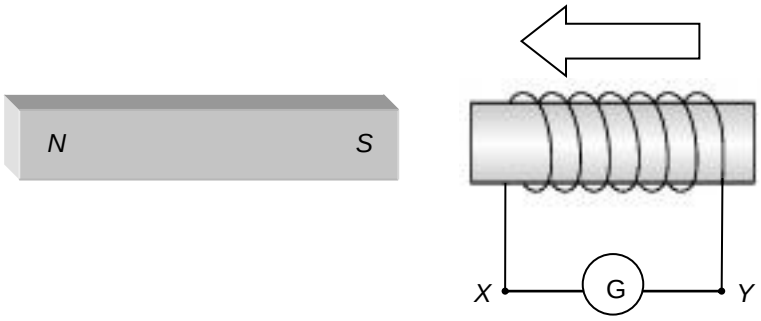
(1 mark)

(b)



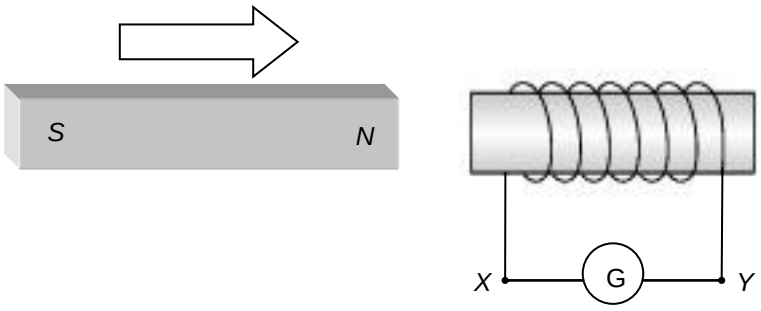
(1 mark)

(c)



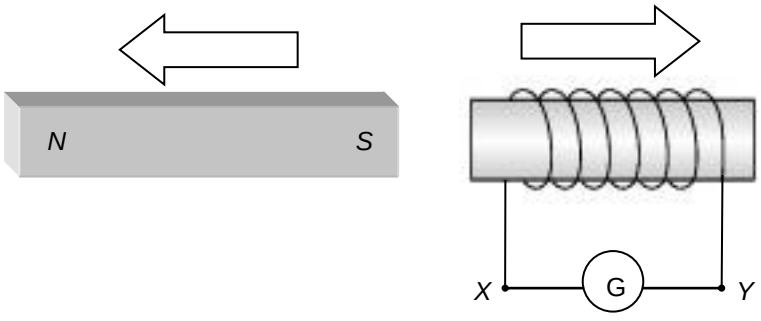
(1 mark)

(d)



(1 mark)

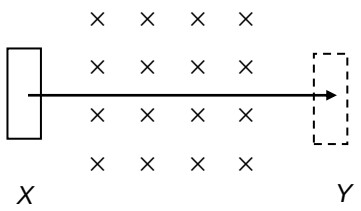
(e)



(1 mark)

4152007

★ A rectangular coil is moved at a uniform speed from position *X* to position *Y* as shown below. The current induced in the coil varies with time.



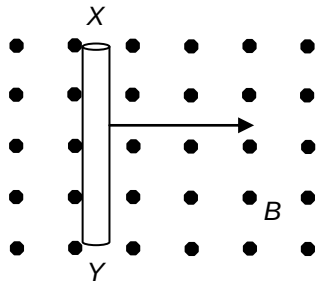
(a) State the Lenz's law. (2 marks)

(b) Sketch the variation of the current induced in the coil with time from position *X* to position *Y*. Take the anticlockwise direction as positive. (3 marks)

4152008

★

F E A metal rod *XY* of length 20 cm moves in a uniform magnetic field of 0.15 T at a speed of 30 cm s^{-1}. The rod is moving at right angle to the magnetic field lines.



(a) What is the potential difference between the ends of the rod? (3 marks)

(b) Which end is at a higher potential? Explain your answer. (3 marks)

(c) If the rod makes an angle of 30° to the direction of motion, what is the potential difference between the ends of the rod? (2 marks)

4152009

★

F E A wire is bent to form a circular coil of one turn. The circumference of the coil is equal to the length l of the wire. The coil is then placed in a uniform magnetic field B with its plane perpendicular to the field.

(a) Derive an expression for the magnetic flux Φ through the coil in terms of l and B. (3 marks)

(b) The same length of wire is now bent to form another circular coil of two turns with smaller radius. The total circumference of the two turns of coil is also l. Derive an expression for the new total magnetic flux Φ' through this coil. Leave your answer in terms of Φ. (3 marks)

4152010

★

F E A solenoids of length 20 cm and radius 2 cm contains 100 turns. It is connected to a power supply so that the current through it rises at a uniform rate of 2 A s^{-1}. Assume that the magnetic field inside the solenoid is uniform.

(a) Find the total magnetic flux through the solenoid if the current is I. (Given the permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}) (3 marks)

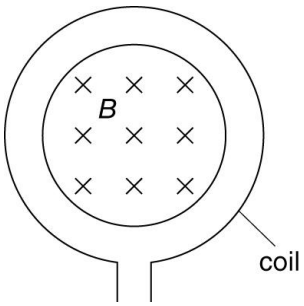
(b) What is the magnitude of the e.m.f. induced in the solenoid due to the changing magnetic field? (3 marks)

Remark: This e.m.f. is called the self-induced e.m.f. since it is induced in the conductor (the solenoid in this case) carrying the current.

4152011

★

F E A uniform magnetic field pointing into the paper is confined to a cylindrical volume of radius 10 cm. A circular coil of radius 12 cm is placed so that its plane is perpendicular to the magnetic field as shown. The magnetic flux density now decreases at a constant rate of 0.01 T s^{-1}.



(a) What is the direction of the induced e.m.f. in the coil? Explain your answer. (2 marks)

(b) Calculate the magnitude of the induced e.m.f. in the coil. (3 marks)

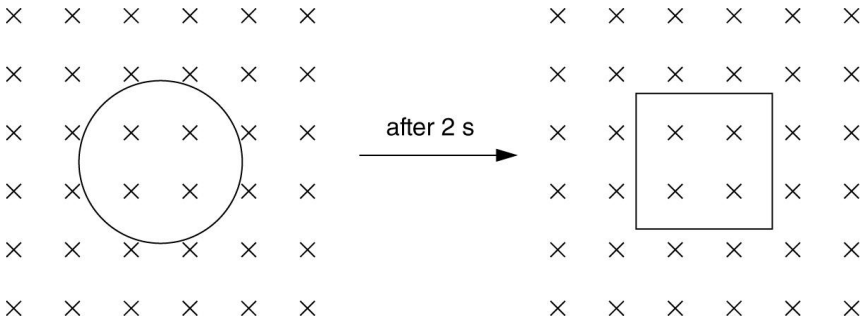
4152012

★

F E A wire of length 16 cm is bent to a circular wire frame and placed in a uniform magnetic field of 0.5 T pointing into the paper. Its shape is then changed into a square in 2 s.

(a) What is the direction of the induced current in the frame through this period? Explain your answer. (3 marks)

(b) Calculate the average induced e.m.f. in the frame in this period. (3 marks)



4152013

★

F E A circular coil made of copper wire is perpendicular to a magnetic field. The radius of the coil is 8 cm. The magnetic field is uniformly increased with a rate of 10 mT s^{-1}.

(a) Find the magnitude of the induced e.m.f. in the circular coil. (3 marks)

(b) If the resistivity of copper is $1.68 \times 10^{-8}\ \Omega$ m and the radius of the copper wire is 1 mm, calculate the rate of energy dissipated in the coil. (3 marks)

4152014

★

F E A copper wire is bent into a circular coil and is placed at a right angle to a uniform magnetic field. The diameter of the wire and the coil are 1 mm and 10 cm respectively. The resistivity of copper is $1.68 \times 10^{-8}\ \Omega$ m.

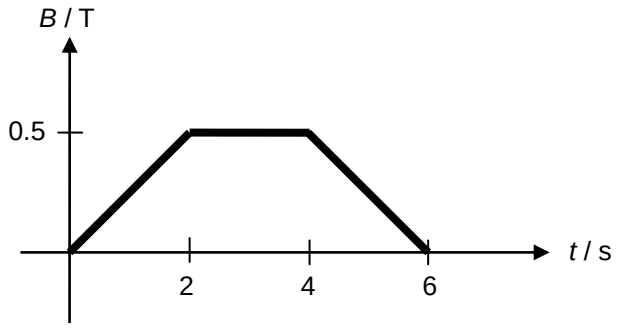
(a) Calculate the resistance of the wire. (2 marks)

(b) The current induced in the coil is 1 A. What is the magnitude of the rate of change of magnetic field? (3 marks)

4152015

★

F E A magnetic field passes perpendicularly through a circular coil of radius 12 cm. The magnetic field changes with time t as show below.



Calculate the magnitude of the induced e.m.f. in the coil in each of the following time intervals:

(a) $t = 0$ to $t = 2$ s;

(b) $t = 2$ s to $t = 4$ s; and

(c) $t = 4$ s to $t = 6$ s.

4152016

★

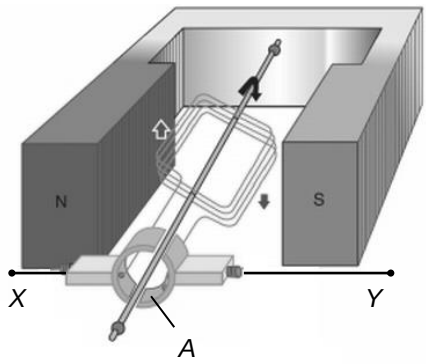
F E A car is moving at a speed of 90 km h^{-1}. There is an antenna of length 1.1 m installed in the car for the radio system. The magnetic field at that region is about 55 μT.

(a) What is the condition for the maximum e.m.f. to be generated in the antenna? (1 mark)

(b) Find the magnitude of the maximum induced e.m.f. in the antenna. (3 marks)

4152017

★ The following figure shows a simple d.c. generator.



(a) If ends *X* and *Y* are connected to a voltmeter to measure the voltage output of the generator, which end should be connected to the positive terminal of the voltmeter, *X* or *Y*? (1 mark)

(b) Name part *A* and describe its function briefly. (3 marks)

(c) State two ways to increase the amplitude of the voltage output without changing its frequency. (2 marks)

4152018

★ An induction cooker of power 2.6 kW is connected to a 220-V power supply.

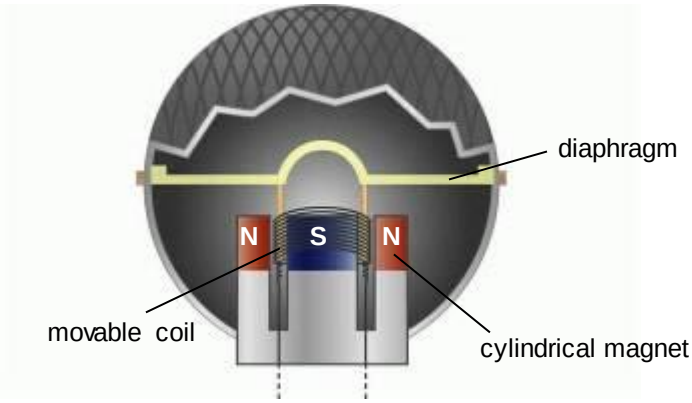
(a) What is the current drawn from the power supply? (2 marks)

(b) Which fuse should be connected to this cooker, 10-A or 15-A? (1 mark)

(c) Explain briefly the working principle of an induction cooker. (4 marks)

4152019

★ The following figure shows the cross-section of a moving-coil microphone. It consists of a cylindrical magnet whose north pole is arranged in the outer part. A movable coil is mounted at the south pole.



(a) The coil is pulled upwards. What is the direction of current induced in the coil when it is viewed from the top? (1 mark)

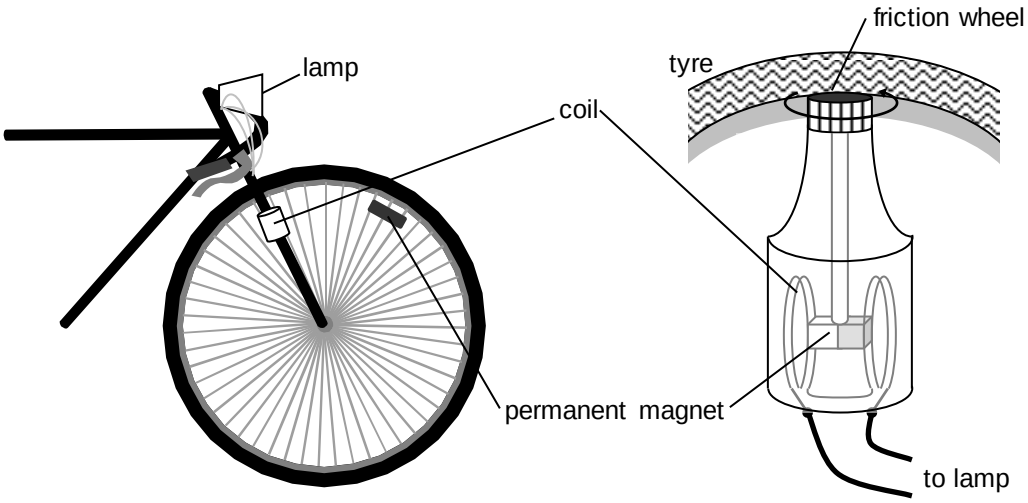
(b) (i) When someone sings into the microphone, the diaphragm of the microphone vibrates up and down. What happens to the current in the coil? (1 mark)

(ii) How is the frequency of the sound related to the frequency of the current in the coil. (1 mark)

(iii) A student argues that the frequency of the current in the coil will be doubled if the number of turns of the coil is doubled. Comment on his statement. (2 marks)

4152020

★ Based on the old design of bicycle dynamo, a student makes a new design to generate electricity for a bicycle lamp.



(a) Give one advantage of the new design over the old design. Explain it briefly. (2 marks)

(b) Give one disadvantage of the new design and suggest how it can be improved. (3 marks)